Chapter 1
Introduction

1-1. Purpose

This manual provides guidance and assistance to design engineers in the development of electrical designs for new hydroelectric power plants. The manual should be used when preparing electrical designs for hydroelectric power plants for civil works facilities built, owned, or operated by the Corps of Engineers. Treatment of electrical systems for pumped storage plants is not covered in the manual, although much of the information is applicable to pumped storage plant systems and subsystems.

1-2. Applicability

This manual is applicable to all civil works activities having responsibilities for the design of hydroelectric power plants.

1-3. References

Required and related publications are listed in Appendix A.

1-4. Scope

a. Generator rating. The manual presents good engineering practice in designing electrical systems for hydroelectric power plants employing generating units of up to approximately 300 *MW* in rating.

b. Plant features. The manual deals with the electrical features of hydroelectric power plants, and covers the generating equipment, station service, various switchyard and transmission line arrangements, details of lighting, communication and control, and protective devices for plant equipment and related auxiliaries. Generators and power transformers are treated under their respective headings, but other equipment, materials, and devices are discussed under the distinct functional systems in which they are used.

c. Specification preparation. Information is presented to facilitate the preparation of specifications for major items of equipment using pertinent approved guide specifications, and specifications for suggested plant design features which take into consideration the numerous ancillary and control details that are required to carry out the intended plant function. Where alternate designs of functional systems are discussed, a preferred design is indicated to secure a degree of uniformity in plants of similar size and character. These preferred designs should be followed unless unusual conditions make them unsuitable or unreasonably expensive.

1-5. Codes

Portions of the codes, standards, or requirements published by the associations or agencies listed below are applicable to the work. A complete listing of codes, standards, and guides is contained in Appendix A, "References."

Institute of Electrical and Electronics Engineers (IEEE)

American National Standards Institute (ANSI)

Electric Power Research Institute (EPRI)

Illuminating Engineering Society (IES)

National Electrical Manufacturers Association (NEMA)

National Fire Protection Association (NFPA)

Underwriters Laboratory (UL)

1-6. Criteria

a. Preferred methods. The design methods, assumptions, electrical characteristics criteria, details, and other provisions covered in this manual should be followed wherever practicable. The manual was prepared for use by engineers with basic knowledge of the profession, and judgment and discretion should be used in applying the material contained herein. In cases where preferred alternatives are not identified, designers should follow recommendations contained in the reference materials listed in the Bibliography that apply to the work to be performed.

b. Deviations from preferred methods. Departures from these guides may be necessary in some cases in order to meet special requirements or conditions of the work under consideration. When alternate methods, procedures, and types of equipment are investigated, final selection should not be made solely on first cost, but should be based on obtaining overall economy and security by giving appropriate weight to reliability of service, ease (cost) of maintenance, and ability to restore service within a short time in event of damage or abnormal circumstances. Whether architect-engineers or

Hydroelectric Design Center personnel design the power plant, the criteria and instructions set out in Appendix A of Guide Specification CE-4000 should be followed.

1-7. Hydroelectric Design Center (HDC)

The engineering of hydroelectric projects is a highly specialized field, particularly the engineering design and engineering support of operational activities. In order to assist field operating activities (FOA), the Corps of Engineers has established the Hydroelectric Design Center (HDC) as the center of expertise in the Corps of Engineers for this work. The FOA will retain complete responsibility and authority for the work, including funding, inspection, testing, contract management, and administration. The HDC will perform the following engineering and design services:

a. Provide the technical portions of reconnaissance reports and other pre-authorization studies for inclusion by the requesting FOA in the overall report.

b. Provide the architectural, structural, electrical, and mechanical design for the powerhouse including switchyards, related facilities, and all hydraulic transient studies.

c. Prepare preliminary design reports and the feature design memorandums for hydroelectric power plants for the requesting FOA.

d. Prepare plans and specifications for supply and construction contracts and supplemental major equipment testing contracts.

e. Provide technical review of shop drawings.

f. Provide technical assistance to the Contracting Officer's representative at model and field tests. The HDC will analyze results and make recommendations.

g. Assist in preparation of Operation and Maintenance Manuals.

h. Provide necessary engineering and computer-aided drafting (CAD) work to incorporate "as-built" changes into the electronically readable "record" drawing files, and assure complete coordination for such changes.

i. Participate in review of plans and specifications for non-Federal development at Corps of Engineers projects in accordance with ER 1110-2-103.